

Critical species of Odonata in the Comoros, Seychelles, Mascarenes and other small western Indian Ocean islands

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ABSTRACT

For the Odonata species known from islands in the western Indian Ocean – excluding Madagascar – comments on 33 species of conservation concern are given.

REGIONAL DEFINITION

There are numerous islands in the western Indian Ocean. This report focuses especially on the archipelagos of the Comoros, central Seychelles and Mascarenes. The Chagos, Maldives and several small islands are also included. Madagascar is covered by a separate report (Dijkstra & Clausnitzer 2004), Pemba, Zanzibar and Mafia, which are next to the East African coast are covered by Clausnitzer (2004), Soqotra by Jödicke et al. (2004).

No dragonflies are known from Indian Ocean islands south of 30°S, such as Amsterdam, Saint-Paul, Prince Edward Islands, Crozet Islands or Kerguélen Islands. Amsterdam and Saint-Paul have a cold temperate climate, and all the others have a polar climate.

The Seychelles, Comoros and Mascarenes are all regarded as biodiversity hot spots of high conservation priority (Myers et al. 2000). All islands under consideration have a tropical character, but differ significantly in their origin and topography. Several of the Seychelles are Gondwana remnants, whereas the Comoros and Mascarenes are younger, volcanic islands. A third type, represented by islands of the outer Seychelles and several isolated islands and also smaller groups which do not belong to any of the three archipelagoes, is coral reef islands. The Central Seychelles are mainly granitic/granite. They were separated from the Indian subcontinent during the break-up of Gondwana about 65 million years ago. All other islands treated in this paper have never been united to any continental landmass.

The volcanic islands also show clear differences in their habitats. Both the Comoros and the Mascarenes were formed by volcanic activity from volcanic hot spots, and therefore all islands significantly differ in age, altitude, degree of erosion and types of waters. Thus, they all have to be treated as an individual in relation to their neighbours.

The fauna of all archipelagos is a combination of invasive species from Australasia, Africa and Madagascar as well as endemic species. On all islands, the flora and fauna are heavily influenced by human colonization.

Politically, the islands under consideration are divided as follows:

Republic of Seychelles:

Central Seychelles including Mahé, Praslin and Silhouette; and the Amirants, Alphonse, Aldabaras, Farquhar Group and others.

Republic of Mauritius:

Mauritius, Rodrigues and a number of smaller islands north and north-east of Mauritius, e.g. Agalea and St. Brandon.

Federal Islamic Republic of the Comoros: The three western major islands of the Comoros, viz Njazidja, Mwali and Nzwani.

Republic of Maldives: 20 atolls with 1,087 islands of the Maldives archipelago.

France: La Réunion belongs to the French mainland as a Département d'Outre-Mer, including several small islands around Madagascar, viz Tromelin, Îles Glorieuses, Juan de Nova, Bassas da India and Europa. Mayotte, the easternmost main island of the Comoros, has a status as Collectivité Territoriale.

The Chagos Archipelago is a British Indian Ocean Territory, politically claimed by the Republic of Mauritius.

STATE OF THE ART

Studies on taxonomy, ecology and biodiversity

In the beginning of odonatology the smaller Indian Ocean islands represented the best explored tropical regions in the world and several species were described in the classic works of Drury (1770-1782), Desjardins (1835), Burmeister (1839) and Rambur (1842). Since 1869, there is a continuous flow of publications on the Odonata of the Seychelles, by Selys (1869a, 1869b), Wright (1869) Calvert (1892, 1898), Martin (1895, 1896), Laidlaw (1908), Campion (1913), Fraser (1949b), Blackman & Pinhey (1967), Samways (1998, 1999, 2003a), Wain & Wain (1998), Wain et al. (1999), Bowler (2001), Kohler (2001) and Bowler (2003).

The Odonata of La Réunion are well known. They have been investigated by Selys (1863a, 1863b, 1872, 1877), Förster (1906), Fraser (1957), Starmühlner (1979), Jacquemin (1988), Couteyen & Papazian (2000a, 2000b, 2000c), Mashaal (2000) and Martens (2001). Mauritius is also well surveyed, by studies of Selys (1863a, 1863b, 1872, 1877), Fraser (1949a, 1949b, 1950), Pinhey (1955, 1976, 1981), Starmühlner (1979) and Martens (2001). However, the taxonomic status and present situation of some Mauritian taxa need further study. The knowledge on the

Table 1. Critical Odonata in the region and their range of distribution. DD: data deficient, might have to be deleted from list with increasing survey efforts; RR: range restricted; IC: identity of (sub)species needs clarification; A: action recommended, because of habitat destruction.

Family/species	DD	RR	IC	A	Known distribution and notes
Lestidae					
<i>Lestes unicolor</i> McLachlan, 1895	●	○	○	○	Endemic to Aldabra, Cosmoledo and Madagascar
Megapodagrionidae					
<i>Allolestes macclachlani</i> Selys, 1869	○	●	○	○	Genus endemic to the Seychelles islands of Mahé, Praslin, Silhouette
<i>Nesolestes pauliani</i> Fraser, 1951	○	●	○	●	Endemic to Mwali, known from type only
Coenagrionidae					
<i>Argiocnemis solitaria</i> (Selys, 1872)	○	●	●	●	Species status doubtful, endemic to Rodrigues, known from female type only
<i>Azuragrion kauderni</i> (Sjöstedt, 1917)	●	○	○	○	Endemic to Comoros and Madagascar
<i>Coenagrionc nemis insularis</i> (Selys, 1872)	○	●	○	○	Endemic to Mauritius, genus endemic to Mascarenes
<i>ramburi</i> Fraser, 1950	●	●	●	○	Endemic to Mauritius, known from types only, genus endemic to Mascarenes
<i>reuniensis</i> (Fraser, 1957)	○	●	○	○	Endemic to La Réunion, genus endemic to Mascarenes
<i>rufipes</i> (Rambur, 1842)	○	●	○	○	Endemic to Mauritius, genus endemic to Mascarenes
<i>'Enallagma' maldivense</i> Laidlaw, 1902	●	●	●	●	Endemic to the Maldives islands of Mahloos und Hulule; known from types only
<i>Ischnura vinsoni</i> Fraser, 1949	○	●	○	○	Endemic to Mauritius
<i>Pseudagrion mohelii</i> Aguesse, 1968	○	●	○	○	Endemic to Mayotte and Mwali
<i>pontogenes</i> Ris, 1915	○	●	○	○	Endemic to Mayotte and Ngazidja
<i>punctum</i> (Rambur, 1842)	○	○	○	○	Endemic to Mascarenes and Madagascar
<i>Teinobasis alluaudi</i> (Martin, 1896)	●	○	●	●	Coastal forests of SE Kenya, E Tanzania, N Malawi, Seychelles, Madagascar
Platycnemididae					
<i>Leptocnemis cyanops</i> (Selys, 1869)	○	●	○	○	Genus endemic to the Seychelles islands of Mahé, Praslin and Silhouette
<i>Platycnemis agrioides</i> Ris, 1915	○	●	○	●	Endemic to Mayotte
<i>mauriciiana</i> Selys, 1863	○	●	●	○	Species status doubtful, known from the incomplete type of doubtful origin (Mauritius) only
<i>melanus</i> Aguesse, 1968	○	●	●	○	Endemic to Nzwani, known from type only
Aeshnidae					
<i>Gynacantha bispina</i> Rambur, 1842	○	○	●	●	Endemic to La Réunion and Mauritius, records from Comoros and Madagascar unconfirmed
<i>stylata</i> Martin, 1896	○	●	○	○	Endemic to the Seychelles islands of Mahé, Praslin and Silhouette

Family/species	DD	RR	IC	A	Known distribution and notes
Corduliidae					
<i>Hemicordulia similis</i> (Rambur, 1842)	○	●	●	●	Endemic to Mahé and Madagascar
<i>virens</i> (Rambur, 1842)	○	●	●	○	Endemic to Mauritius
<i>Nesocordulia villiersi</i> Legrand, 1984	○	●	○	○	Endemic to Mwali, known from type only
Libellulidae					
<i>Diplacodes lefebvrei</i> tetra (Rambur, 1842)	○	●	●	○	Mauritius
<i>Orthetrum azureum lugubre</i> Ris, 1915	○	●	●	○	Species endemic to Comoros (ssp. <i>lugubre</i>) and Madagascar (nominate ssp.)
<i>stemmale wrightii</i> (Selys, 1869)	○	●	●	○	Endemic to Seychelles
<i>Thalassothemis marchali</i> (Rambur, 1842)	○	●	○	○	Genus endemic to Mauritius
<i>Thermorthemis comorensis</i> Fraser, 1958	○	●	●	○	Endemic to Ngazidja, species status doubtful
<i>Trithemis annulata haematinus</i> (Rambur, 1842)	○	●	●	○	La Réunion, Mauritius
<i>selika maia</i> Ris, 1915	○	●	●	○	Endemic to Comoros
<i>Zygonyx luctifera</i> Selys, 1869	○	●	○	○	Endemic to the Seychelles islands of Mahé, Praslin and St. Anne
<i>torridus insulanus</i> Pinhey, 1981	○	●	●	○	Endemic to Mauritius

¹ See text for use of genus name

Odonata of Rodrigues is unsatisfying. It is based on a species description by Selys (1872) and some brief remarks by Smith (1879) and a critical review of Campion (1923) only. No recent material is available.

Compared to their significance in biodiversity (Myers et al. 2000), the Odonata of the Comoros are badly known. The most important publication is Ris (1915). Grünberg (1917) lists some additional records. Since that period a few species are added in taxonomic (Fraser 1951, 1958; Aguesse 1986; Legrand 1984; Gauthier, 1988) or hydrobiological papers (Starmühlner 1979). Recently, studies have been made only on Mayotte by Samways (2003b) and A. Martens (unpubl.).

Recent data including reviews are available from Chagos Archipelago (Barnett & Emms 1997) and the Maldives (Olsvik & Hämäläinen 1992). Only a few, mostly old, records are known from the island Europa (2 spp., Grünberg 1917; Fraser 1956), the îles Glorieuses (2 spp., Calvert 1898; Fraser 1956), the Aldabra group, e.g. Assumption (6 spp., Campion 1913), Cosmoledo (1 sp., Campion 1913) and Aldabra (5 spp., Campion 1913; Blackman & Pinhey 1967, also as a review). As far as we know, no Odonata records exist from the Amirants, Farquhar and other islands of the outer Seychelles, Juan de Nova, Bassas da India, Tromelin, Agalea, and St. Brandon.

Studies on the ecology of Odonata in the western Indian Ocean islands are rare. The knowledge on the fauna is based on material collected by non-odonatologists for long times. With short trips to Mauritius in 1976 and La Réunion in 1986, E. Pinhey and G. Jacquemin, respectively (Pinhey 1976; Jacquemin 1988), were the

first specialists who visited an Indian Ocean island themselves. Since then, and also by local odonatologists, the knowledge on dragonfly habitats and ecology inclines significantly (e.g. Wain & Wain 1998; Couteyen & Papazian 2000c; Martens 2001; Bowler 2003; Samways 2003b).

Identification guides and faunal lists

For the Seychelles a very useful identification key to imagines was published by Blackman & Pinhey (1967), the key for the Mascarenes by Fraser (1949a: Zygoptera, 1950: Anisoptera) lacks some newly described species and the newer records for the region. For the Comoros no identification key exists. In all cases literature from neighbouring regions has to be consulted, e.g. from India (Fraser 1933, 1934, 1936), Madagascar (Fraser 1956; Schmidt 1966) and/or eastern Africa entitled, "The dragonflies of eastern Africa – an identification key", being prepared for publication by V. Clausnitzer & K.-D.B. Dijkstra.

Faunal lists are available for the Seychelles in Blackman & Pinhey (1967) and Samways (2003a), the Comoros in Dijkstra (2004), the Mascarenes in Pinhey (1962) and Couteyen & Papazian (2000a), the Maldives in Olsvik & Hämäläinen (1992) and the Chagos islands in Barnett & Emms (1997).

CRITICAL SPECIES

Species previously listed by IUCN

For the three archipelagos only three species have been listed in the Red List of threatened species (IUCN 2003):
as critically endangered [CR]:

Argiocnemis solitaria (Rodrigues), *Seychellibasis* (syn. *Teinobasis*) *alluaudi* (Seychelles), *Platycnemis mauriciana* (Mauritius).

Additionally three dragonfly species were listed as priority species for the eastern African region by Moore (1997):

as monotypic genera confined to one country only:

Allolestes maclachlani (Seychelles), *Leptocnemis cyanops* (Seychelles), *Thalassothemis marchali* (Mauritius).

Concerning the listed species by Moore (1997) and the IUCN (2003) it has to be noted, that:

A. solitaria is known from the female type only. A second *Argiocnemis* record from 1918 without identification to the species level is reported by Campion (1923).

No further data are available.

The taxon *P. mauriciana* is based on an incomplete male type only, and the locality Mauritius is doubtful and queried by the author himself (Selys 1863a, 1877; Fraser 1949a). Selys (1886) did not list *P. mauriciana* again in his review of the *Platycnemis* group. Fraser (1949a) summarised the doubts of Selys (1863a) and remarked that the short description is closely similar to that of *P. hova* Martin,

1908 from Madagascar. However, he did not delete it from the Mauritius list. Pinhey (1962) listed it in his checklist of Mauritius without further comments. Samways (2002) let the taxon tentatively remaining on the Red List. During three field trips on Mauritius in 1997-1999, A. Martens (unpubl.) did not find any *Platycnemis*.

The status of *T. alluaudi* has been re-assessed in the meantime (Clausnitzer 2004) and an overview of the known populations and taxonomic problems is given in Clausnitzer (2003). *T. alluaudi* has been recorded from localities in Madagascar, Kenya and Tanzania as well.

Species to be considered

A high number of species from the Indian Ocean islands can be listed as 'data deficient' and/or 'critically endangered' (Table 1). These species are usually endemic to one island or to a small group of islands, where habitats have been and still are destroyed rapidly. Most, if not all endemic species are forest stream species, while the widespread species primarily inhabit open standing waters. Before the arrival of humans, forested running water was probably the only type of freshwater on the islands, while pools were rare and unpredictable.

Subspecies from species common on the African mainland have been identified for some of the islands, the status of most of them need revision, preferably with genetic methods. For many of these species conservation measures are urgently needed.

The genus *Enallagma* was revised by May (2002) resulting in a separation of the African species from the Holarctic *Enallagma*. The former are divided into five new genera. *E. maldivense* was not included in May's study due to lack of material. Thus the correct genus remains open.

CRITICAL SITES AND THREATS

The natural habitats of all islands have suffered seriously from deforestation, erosion and pollution in the last century. As deforestation progresses, soils are washed away and watersheds lost. The situation seems to be extremely severe on the Comoros (Safford 2001b). In all archipelagos the protection of forests is regarded with growing urgency, because it is the only way to safeguard the water sources on which not only the dragonfly fauna is dependent.

Another general conservation problem on all islands is the destruction of the native and the invasion of exotic flora. Beside forest plants this also concerns aquatic habitats. On Mauritius and La Réunion the introduced *Eichhornia crassipes* is advancing and begins to cover many waters in the lowlands. No information is available, indicating whether this is affecting Odonata. Human impact is most severe in the scarce permanent aquatic resources in the lower elevations on the islands, which of course are the prime habitats of the endemic odonate fauna (Samways 2003a, 2003b). Because of the advanced destruction of the natural habitats in the lower elevations it is not possible to determine whether species confined to middle and higher elevations nowadays, occurred commonly in the lower elevations prior to human disturbance (Samways 2003b).

For an overview of the general conservation status of the natural habitats of the islands see Rocamora & Skerrett (2001) and Samways (2003a) for the Seychelles, Samways (2000) and Safford (2001a) for the Comoros, Safford (2001b) for Mauritius, Safford (2001c) for Mayotte and Le Corre & Safford (2001) for La Réunion.

CONSERVATION PRIORITIES AND RECOMMENDATIONS

The protection of the remaining forests on all islands is crucial for the survival of the unique dragonfly fauna living there. Destruction has led to fragmentation of what remnants remain. Isolated forests are particularly vulnerable to further disturbance. Linking up fragments by creating forest corridors between them can form larger networks, which can support greater biological wealth. Tools are needed to measure degrees of landscape disturbance, as well as conservation success. Water pollution is another important issue on most islands, which could be solved with simple measures in many cases, e.g. creation of sinks (Samways 2000).

Conservation priorities are listed for the Seychelles in Rocamora & Skerrett (2001) and Samways (2003a), for the Comoros in Samways (2000) and Safford (2001a), for Mauritius in Safford (2001b), for Mayotte in Safford (2001c) and for La Réunion in Le Corre & Safford (2001). An overview of recommendation for ecosystem restoration on islands is given in Samways (2000). Beside this, special attention should be payed on unique habitats, e.g.

the Etang de St.-Paul on La Réunion; a natural lake in the north-west including remnants of swamps. La Réunion is poor in permanent lentic waters, especially in the lowlands, where there is the highest human pressure;
the Lake Dziani Karihani on Mayotte; a small natural lake in the west of the island.

There is no endemic species known to be restricted to these localities, but habitats like this may be a stepping stone to habitats with biogeographical significance.

RESEARCH PRIORITIES

Surveys on the dragonflies of Njazidja, Mwali and Nzwani (all Comoros) and Rodrigues are urgently needed, covering all aspects from basic inventories and systematic work to studies on ecology, biogeography and conservation related issues. Further endemics could be expected from the Comoros, but unfortunately all four mentioned islands belong to the most deforested in the region. A number of species are known from the types only (Table 1), others have not been recorded for many years, like *Ischnura vinsoni*, *Hemicordulia similis*, *H. virens* or *Thermorthemis comorensis*.

Several endemic subspecies from Madagascar or widespread African species have been described from the islands, viz *Diplacodes lefebvrei tetra*, *Orthetrum azureum lugubre*, *Orthetrum stellmale wrightii*, *Trithemis selika maia*, *Trithemis arteriosa haematina* or *Zygonyx torridus insulanus*. As already mentioned it would be useful

to approach these taxa with genetic methods. Inventories should be published which offer more information on the distribution patterns within an island. Ecological studies should focus on habitat requirements of forest species, both in larvae and imagines. Special attention should be drawn on the role of fine sediments washed into the waters, on predation by introduced fish and on competition with species of open habitats. Many of the islands are in an area with strong cyclones. The impact of cyclone events on dragonfly populations and habitats should be investigated. Cyclones may also have an influence on faunal exchange especially in the migratory and opportunistic species with a preference for open and temporary habitats. The faunal exchange/isolation in these islands is an interesting problem, which should be approached by using molecular methods.

CURRENT ACTIVITIES

Over the last years several aspects of the Seychelles odonates have been studied. The results have often been reported in 'Phelsuma', the scientific journal of "The Nature Protection Trust of the Seychelles" (NPTS); for more information check <<http://members.aol.com/jstgerlach/phelsuma.htm>> or contact <npts@seychelles.net>. In 2000, the Société Française d'Odonatologie has put a special focus on the Odonates of the French overseas departments and territories. An issue of its journal 'Martinia' included several contributions on dragonflies of La Réunion (Couteyen 2000; Couteyen & Papazian 2000a; Mashaal 2000) and will stimulate further activities. K.-D.B. Dijkstra is currently working on a revision of the genus *Hemicordulia* from Africa and Asia.

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